TRINITY COLLEGE

YEAR 12   **Test 3, 2023**
MATHEMATICS   **Calculator Allowed**
APPLICATIONS   **Time Series and Finance**

STUDENT'S NAME: _____

DATE: Wednesday 2nd August   **TIME:** 50 minutes   **MARKS**: 46
                                                                                      ASSESSMENT %: 10

INSTRUCTIONS:
Standard Items: Pens, pencils, drawing templates, eraser, Formula Sheet.
Special Items: 1 A4 page notes, Classpad, Scientific Calculator

Questions or parts of questions worth more than 2 marks require working to be shown to receive full marks.

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Question 1   **(3 marks)**

Mrs Smith is investigating two investment options. Using mathematical reasoning determine which investment is better.

Investment A: $1000 invested at 8% p.a. compounded quarterly for 5 years.

Investment B: $1000 invested at 7.5% p.a. compounded weekly for 5 years.

Question 2 **(6 marks)**

Dave Sullivan was gifted a large sum of money from a recently passed uncle and decided he would use it for two specific investments.

(a)   He wanted to make an ongoing yearly payment for 20 years to a well deserving Year 12 student at his local school. He decides that between school fees, uniforms, excursions, the cost of Year 12 is approximately $20,000. He finds a bank which offers 6.5% p.a. compounded monthly. How much should he invest? (3 marks)

(b)   For the second investment Dave decides to invest $480,000, in a perpetuity. The Bank of Perth is offering 7.25% p.a. compounded weekly. What annual payment could he withdraw from the account? (3 marks)

Question 3   **(6 marks)**

Terry invested $100 000 at 6% per annum, compounded monthly. He withdrew $5000 each month after the interest is paid.

| Month	Opening Balance	Interest	Payment	Balance
1	$100 000	**A**	$5 000	**B**
2	**B**	$477.50	$5 000	$90 977.50
3	$90 977.50	$454.89	$5 000	**C**

(a)   Determine the values of **A**, **B** and **C**.   (3 marks)

(b)   Determine how long Terry could withdraw $5 000 per month before the money ran out.

                                                                            (3 marks)

Question 4 **(5 marks)**

Consider the graph of the Unemployment Rate of Persons aged 15-24 from November 2002 until November 2011 from the Australian Bureau of Statistics

(http://www.abs.gov.au/websitedbs/a3121120.nsf/home/statistical+language++time+series+data)
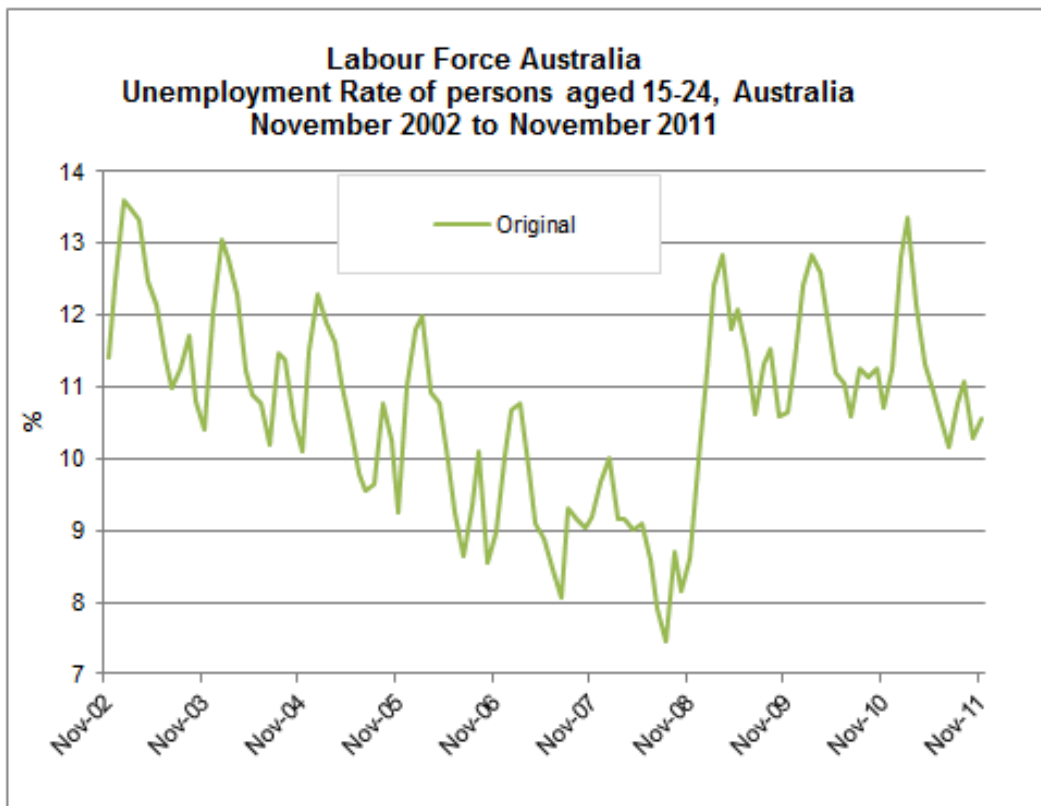
(a)   Comment on the trend and seasonality of the graph from November 2002 until November 2007

(2 marks)

(b)   The Global Financial Crisis occurred towards the end of 2008. Comment on the effect of the crisis on the unemployment and also the seasonality of the data after that time.   (3 marks)

Question 5   **(8 marks)**

Kitty has retired with a superannuation balance of \$580 000. An investment has an interest rate of 5.7% per annum, added monthly. She decides on receiving a monthly annuity of \$6000 with the interest added before the annuity is paid, at the end of each month.

(a) The annuity can be modelled by the recurrence relation

$$T_{n+1} = (1+0.00475)T_n - 6000, \quad T_0 = a$$

Using the information given in the question, show how to obtain the value 0.00475 and state the value of a.   (2 marks)

(b) For how many months will Kitty be able to receive the annuity of \$6000?   (1 mark)

(c) Determine the amount of the final payment.   (2 marks)

(d) Determine the total interest received on the annuity.   (3 marks)

Question 6 (11 marks)

The data below shows the number of cars washed for 18 days by a carwash company.

Week	Day	n	Number of Bookings	Seasonal Mean	Number of bookings as a percentage of the seasonal mean	Seasonally adjusted figures
1	Mon	1	8		58.82	14.2
	Tue	2	11		80.88	13.3
	Wed	3	12	13.6	88.24	13.7
	Thu	4	17		**A**	13.5
	Fri	5	20		147.06	13.5
2	Mon	6	8		55.56	14.2
	Tue	7	12		83.33	14.5
	Wed	8	12	14.4	83.33	13.7
	Thu	9	19		131.94	15.1
	Fri	10	**C**		145.83	14.2
3	Mon	11	9		54.22	15.9
	Tue	12	14		84.34	16.9
	Wed	13	15	**B**	90.36	17.2
	Thu	14	20		120.48	**D**
	Fri	15	25		150.60	16.9
4	Mon	16	10		-	
	Tue	17	16	-	-	
	Wed	18	19		-	

(a)   Calculate the values of **A**, **B**, **C** and **D** in the table.   (4 marks)

(b)   Give a reason why time series data are deseasonalised.   (1 mark)

(c)   Calculate the seasonal index for Friday.   (1 mark)

(d)   The equation of the least-squares line using the sesonally adjusted figures is: $y = 0.26n + 12.75$

      (i)   How does this equation support the observation that the number of cars washed is increasing?   (1 mark)

      (ii)   Use this equation to predict the number of cars that will be washed for the Friday of Week 6.   (2 marks)

      (iii)   Comment on this prediction.   (2 marks)

Question 7   **(7 marks)**

Mrs Jessup requires a loan of $365 000 for the purchase of a house. She wishes to make fortnightly payments of $1300. She is offered a loan with an introductory rate of 1.75% p.a. compounded daily for the first two years which then changes to a rate of 6.2% p.a. compounded daily for the remainder of the term of the loan.

(a)   Briefly describe the benefits of making two repayments of $1300 per month instead of one repayment of $2600 at the end of the month.   (1 mark)

(b)   Calculate the value of the loan at the end of the first two years.   (3 marks)

(c)   Calculate how many years and months Mrs Jessup will take to pay off the loan.   (3 marks)

END OF QUESTIONS